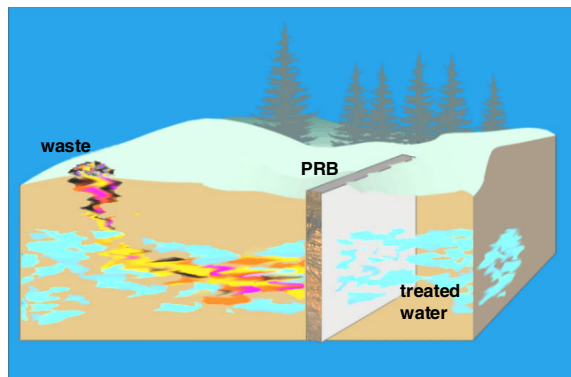


Corrosion products formed on iron granules (SEM micrograph).



**Project Title: “PRB Strategies and Performance Monitoring for Remediation of Inorganic Contaminants”**

**Investigators:** Richard Wilkin and Robert Puls (U.S. EPA, Office of Research and Development, National Risk Management Research Laboratory, GWERD, Ada, OK 74820; 580-436-8874)

**Collaborators:** Federal Tri-Agency Research Initiative (DoD, DOE); Naval Research Laboratory

**Background:** A Permeable Reactive Barrier (PRB) is a zone of granular reactive material that extends below the water table to intercept the flow of contaminated ground water. As organic or inorganic contaminants pass through a PRB, they are ideally reduced to non-hazardous compounds or they are immobilized to less soluble or less toxic forms. Research is focused on assessing the geochemical, hydrogeological, and microbiological factors that govern the performance and functioning of PRBs. Understanding these factors is necessary in order to predict the longevity of PRB systems, conduct economic analyses, and to optimize the implementation of this ground water cleanup technology for a wide variety of hazardous compounds.

**Objectives:** As of 2002, the oldest zero-valent iron PRB systems were about 10 years old. In order to reach the best possible technology selection decisions and to optimize PRB design parameters for ground-water cleanup at contaminated sites, information is needed to identify the site-specific factors that govern continued PRB performance. Two PRB systems installed in 1996 (U.S. Coast Guard Support Center, Elizabeth City, NC; Denver Federal Center, Lakewood, CO) have been extensively monitored to track and evaluate system behavior through time.

**Approach:** This project includes both field and laboratory research components. Detailed performance monitoring data on full-scale Permeable Reactive Barriers (PRBs) installed to treat contaminated ground water have been collected at two different sites. The PRBs investigated in this project are among the oldest full-scale systems available for study and provide an opportunity to analyze the performance of systems with more than 5 years of field history. In addition, the PRBs examined here have contrasting design and hydrogeochemical characteristics that are useful in the context of gaining insight about the factors that govern PRB longevity and long-term performance. Geochemical studies include conventional low-flow ground-water sampling and analysis, and solid-phase characterization investigations. Laboratory batch and column tests using reactive media are conducted to determine the effectiveness of reactive materials such as zero-valent iron to treat a variety of hazardous substances. Contaminant removal mechanisms are identified by careful water chemistry, geochemical modeling, and solid-phase characterization studies.

**Accomplishments:**

- Wilkin, R.T. and Puls, R.W. (2003). Capstone Report on the Application, Monitoring, and Performance of Permeable Reactive Barriers for Ground-Water Remediation, Volume 1: Performance Evaluations at Two Sites, EPA Report, EPA/600/R-03/045a.
- Paul, C., McNeil, M., Beck, F., Clark, P., Wilkin, R. and Puls, R. (2003). Capstone Report on the Application, Monitoring, and Performance of Permeable Reactive Barriers for Ground-Water Remediation, Volume 2: Soil and Ground Water Sampling, EPA Report, EPA/600/R-03/045b.
- Wilkin, R.T., Puls, R.W., and Sewell, G.W. (2003). Long-term performance of Permeable Reactive Barriers using zero-valent iron: Geochemical and microbiological effects. *Ground Water*, v. 41, 493-503.
- Wilkin, R.T. and McNeil, M.S. (2003). Laboratory evaluation of zero-valent iron to treat water impacted by acid mine drainage. *Chemosphere*, in press.
- Furukawa, Y., Kim, J., Watkins, J., and Wilkin, R. (2002). Formation of ferrihydrite and associated corrosion products in Permeable Reactive Barriers of zero-valent iron. *Environmental Science and Technology*, v. 36, 5469-5475.